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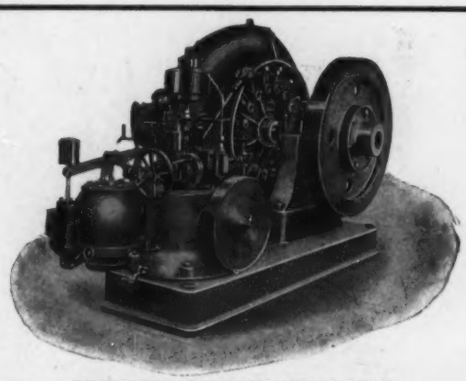

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HUME LAKE DAM

BY JOHN S. EASTWOOD.

The Hume-Bennett Lumber Company, a manufacturing lumber company, with offices and finishing mills at Sanger, Califorina, are the owners of a large tract of timber in the Sierra Nevada mountains 60 miles east of Sanger, on several tributaries of Kings River on the south side of the main canyon, in Fresno County. The timber is sawn into lumber at the mountain mills at Hume, on Ten-Mile Creek, and is transported to Sanger, the nearest railroad point, where it is handled for manufacture and distribution. The lumber is shipped by flotation in a "V" flume 67 miles long, built on steep grades and with sharp curves to fit the rough country over which it passes.

Having cut out all of the timber in Converse Basin, it was determined by the management of the Company to remove the mills to the junction of Ten-Mile and Long Meadows creek, in the heart of the virgin timber, where an entirely new and modern sawmill was erected to cut the timber, the "V" flume being extended to the new site. The tract of timber is estimated to contain about 800 million feet b. m. of timber, consisting of sugar pine, yellow pine, and a large amount of and the only available sequoia gigantea, or "California big tree" timber, now on the market.

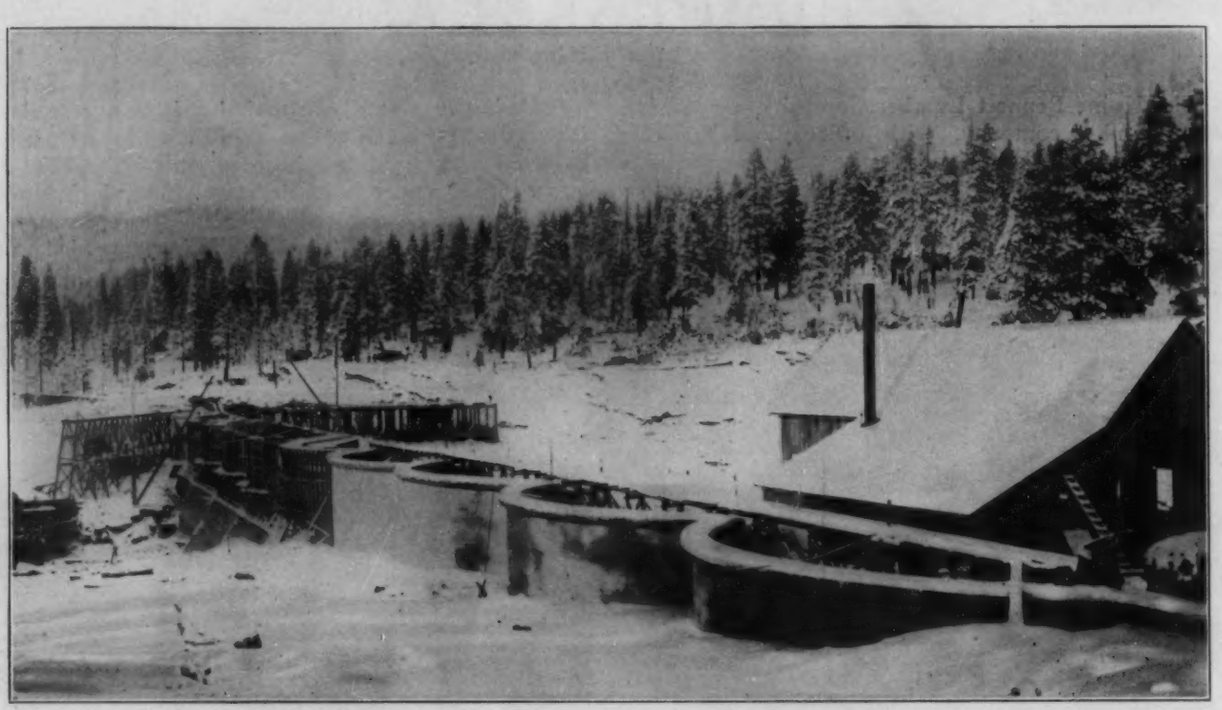
Hume Dam Site Prior to Construction.

As the dry period or season is about half of the year, it was necessary to store a considerable amount

of water for fluming and for a logging pond to carry a stock of logs on hand. A reservoir of 1411 acre-feet was created by building a dam across Ten-mile creek at its junction with Long Meadows creek, where the saw mills and the industrial village of Hume are situated. There is available for storage the run-off from about 25 square miles of drainage area having an altitude of from 5000 feet to 7000 feet above sea level, and as the precipitation is largely in the form of snow which melts quite rapidly, it is necessary to have quite a large capacity to hold over till the succeeding wet season.

A reservoir having a surface area of 87 acres and containing 1411 acre-feet or 61,500,000 cubic feet of capacity was therefore designed, requiring a dam of 50-foot span, resting on 13 buttresses, the end walls from the last buttress at each end being extended into the opposite bank as a core wall, as they are above the normal water line and have no water load.

The elevation of the water line is 5300, that of the crest of the middle six arches is 5303 and the remainder of the crest to the ends is 5304 feet above mean tide level. This allows a 330-foot crest for any freshet that might occur when the spillway flashboards were accidentally left in the spillway openings. These openings will discharge 5328 cubic feet per second when the water line is reached and 12,768 cubic feet when the low part of the crest is reached, and as no storm has shown a greater flow than 2500 cubic feet, there will never be water over the top if half of the flashboards



Front View of Hume Dam Showing Arches.

across the gorge at the junction of the Ten-mile and Long Meadows creeks 61 feet high at the center line and 677 feet long on the crest.

The writer was called in as engineer to design and erect the dam that has been termed the Eastwood multiple arch dam, it being a hollow type of dam, using the arch for the water face. Having had occasion to design dams for a large proposed hydro-electric development on Big creek, a tributary of the San Joaquin river, where the reservoir site called for three dams of considerable size, the subject of dams was gone into with the view of reaching the ultimate type, having in mind the characteristics of permanence and stability, coupled with economic capital cost and upkeep.

The result of the studies is the design of the multiple arch type of concrete dam, consisting of a series of buttresses set parallel to the course of the stream and spaced to suit the conditions at the site to act as supports, and a series of arches connecting these buttresses, acting as the water face and carrying the water thrust to the foundations through the buttresses.

In the Hume-Bennett dam there are 12 arches, each are left out, the extra foot rise being to protect the buildings on either side from freshet in any event. As the entire structure rests on sound bedrock, no overflow can do harm or reach the buildings.

It was found in the studies that to give the required stability with the greatest economy it was desirable to build the top 16 feet of the dam with vertical arches, and all arches up to 20 feet high at the spring line were built vertical. All arches higher than 20 feet are carried vertical to within 16 feet of the top at the crown line, and slope to the foundations at an angle of 32 degrees at the crown line of the extrados of the arch, or 0.625 to 1. The arch ring thickness is increased as required for the water pressure, or at the rate in this structure of one foot to each 24 feet vertical, a vertical base of 3.5 feet height being added at the foundations on the inside at the toe. This vertical base was decreased for the arches of less height to a minimum of 2 feet, following the general dip of the slope of the canyon walls. The arc of the arch rings is 129 degrees 50 minutes at the top for the intrados and decreases as the height increases due to the shortening of the chord

and the radius resulting from the increase in thickness of buttress and arch ring. The arc of the extrados is uniformly 118 degrees from top to bottom from filler to filler, the fillers being 24-inch strips to fill the sharp corners at the intersection of the arches.

A parapet wall of 2 ft. 6 in. is run on the crest of the dam from end to end, this projection being one foot deep and supported by a corbel filler 4 inches high, all corners being clipped, making a cornice finish.

All of the vertical part of the arch wall is 18 in. thick, the wall increasing in thickness from this point at the rate of 1 foot to each 24 feet vertical, being a iittle more than required for water load.

supplies of water for the flume and other purposes connected with the enterprise.

The spillway openings are 12 in number and are located in the three middle arches of the dam, the openings being 5 ft. by 8 ft. each, to be closed to any desired height by means of flashboards. The structure was reinforced throughout where necessary by means of railroad iron scrap and old logging cable.

The site of the dam consists of portions of exposed granite bedrock, near the creek channel, and clay-covered bedrock at the sides, running from a few inches to 18 feet in depth. The pits for the foundations were staked out one foot wider than the finished wall, the

Rear View of Hume Dam Showing Buttresses.

The buttresses are all 2 feet thick at the top and project 8 feet from the inside spring line to the down-stream end, all corners being clipped. The batter of the down-stream end is 5 inches to 1 foot and of the sides 1 in 24 to the base on each side. Each buttress is finished on its down-stream end with wing buttresses or counterforts merging into the main buttress at the top and having a batter of 1 in 8, being 2 feet thick at the top and increasing with a batter of 1 in 24 on the inside only to the foundations, serving to stiffen the downstream end of the buttress and to move the center of resistance toward the down-stream toe. The upstream end of the buttress conforms to the slopes of the arch rings.

Three outlet gates are provided, one of 24 inches diameter and two of 12-inch diameter, placed at the downstream ends of short pieces of pipe laid in the walls. The 24-inch gate serves as a drain gate to draw down the water in the Fall in order to remove logs that may be left on the bottom of the pond at the end of the season. The 12-inch gates are used for

earth cleared off and the bedrock shot up until a sound bearing rock was found for the buttresses and till a sound unseamed bedrock was had for the arch bases, which was roughened by blasting with small shots placed close enough to break into each other, forming a shallow and rough trench.

Near the creek banks the rock was frost heaved, forming bed seams, the scales or layers being of sound rock, the seams in which were followed till they pinched out or were so close that they did not allow water stains to penetrate them. All of the sound rock was lifted by means of a derrick to the stock pile to be afterwards used as concrete aggregate.

After blasting the surface of the rock was washed by means of a hose under pressure and all scales and loose fragments picked off with picks, and when ready for the concrete washed a second time till it was as clean as a fresh fracture. Dry cement was sprinkled over the surface while wet and the concrete immediately laid on this prepared foundation. By actual test with a pick after the final setting it was found that the

union between the rock and the concrete was perfect, the concrete adhering to the rock as if a part of it.

The adhesion of the concrete to the rock, combined with the stepping made necessary by the deeper pits for the arches, makes it a case of shearing of the concrete before sliding can take place in this type of structure.

After excavation a trestle was built across the site on the line of the inside spring line, near the middle of the structure, for the distribution of the material. This trestle was of 4 in. by 6 in. posts and of the standard flume type, to be afterwards removed and used as flume trestle.

It was provided with stringers and 4 in. by 6 in. ties to carry a 24-in. gauge track and was boarded over for a foot runway. The track of 25-lb. rail was afterwards used as part of the tramway system in the lumber yards. The trestle was entirely completed before work on the forms was begun and was used as a base and centering support for the forms, being so compactly braced as to furnish a good foundation for this purpose.

Owing to the position of the rock quarry, the sand pit and the water supply, the concreting plant was located on the west bank of the creek near the center of the structure, the creek being the only water source, and the platforms connected by means of a wheeling trestle to the sand pit, the quarry being a little higher than the main trestle and about 300 feet to the west of it.

A branch line of trestle was built to the quarry and a spur to a point immediately over the rock crusher, where the rock was dumped from side dump Koppel cars run down to the end of the spur by gravity. The rock was blasted and broken in the quarry to one-man size and was further broken in the stock pile to sizes to fit the rock crusher.

The crusher was a No. 2 Gates and was too small for the work, but by running it over time and constant crowding it sufficed. The mixer, a No. 1 Ransome half-yard machine, was set under a platform a little below the level of the crusher discharge and on grade with the wheeling runway from the sand pit, the crushed rock, sand and cement being delivered on this platform and dumped into the hopper. The mixer was run by a separate engine belted to the counter shaft and the drive of the donkey, there being no governor on the engine.

The concrete was taken from the mixer by dumping it into the beds of side-dump Koppel cars, two beds being used and one truck, which remained in position while the bodies were being raised and lowered. One bucket was filled while the other was being dumped, the exchange being made at the chute of the mixer, where the empty was set on skids and as the loaded one was hoisted up the other was slid into its place to be filled. The loaded bucket was lifted to the top of the trestle and lowered to the truck, the bail cables unhooked and the car with its load pushed by two men to its place of discharge and dumped, then returned and lowered to the mixer.

Sand in large quantity and of excellent quality was wheeled from a pit near the mixer plant, being graded from fine on top to a coarse sand at the bottom of the pit, which in loading was mixed by spading it down from the top so that each barrow load contained a part of each grade of sand from fine to coarse. A wheeling trestle was built across the creek and the sand delivered to the mixer platform in barrows. The sand was clean and the few sticks and roots in it were picked out by hand before loading.

The derrick mast was 70 feet high and the boom 65 feet long, allowing a large radius of reach. It was operated by a single drum donkey engine, the boom being raised and fastened at a fixed point and swung by tilting the mast so that the load would swing it, the empty being pulled back by means of a rope attached to the end of it.

Lumber for the forms was furnished by the local temporary mill and hauled to the site, the same team hauling the wood for fuel for the donkey engines. The buttress forms consist of 2 in. by 4 in. studding set about 20 inches apart on centers and spliced where not long enough to reach the top, a frame work being first built and lined with one-inch lumber of 10 and 12-inch widths, lightly nailed to the inside of the studs, the studs being braced to the trestle. The shape of the counterfort forms were such that they braced themselves when once boarded up.

Where an unsupported thrust occurred that could not be well braced from the outside it was taken care of by the use of twisted No. 9 telephone wire. A bulkhead was placed in the front end of the form about 4 feet from the end. The cable reinforcement was left protruding through holes made by sawing notches in the edges of the boards opposite each other. The arch forms were built up from the bottom, using 2-in. by 4-in. studding and ½-in. by 6-in. stuff nailed on double. The studs were first set in their true position and properly spaced and the half-inch stuff nailed on, being bent to fit the circle formed by the studs. The studs were held to their proper place by "liners," or segments of a circle, cut to the template of a pattern and assembled in place in sections, the studs being toenailed to them at the bottom, and through-nailed from the top, set flush with the inside and outside of the liner as the case may be for inside or outside studs. The forms for the cornice of the parapet wall were held in place by means of brackets below and cross braces to the inside forms at the top. The lumber was used fresh from the saw and when put in place for any length of time in advance of the concreting the forms were kept wet at night and by the concreting crew in the day.

The concrete was made from cement furnished by the Standard Portland Cement Co. of San Francisco, the cement being furnished from the Davenport works. It stood all tests and the final test of the working structure shows it to be all that is required in a good cement.

Crushed granite was used for the coarse aggregate, the crusher-run being used with sand from the adjacent pit, the final mix being determined by a series of tests to find the densest concrete possible with the materials at hand, being approximately a 1-2-4 mix, which was used as a standard throughout. As the quantities were small, the quality could be kept to the highest standard.

The broken stone was wheeled direct from the crusher to the mixer and dumped into the hopper, the sand next and the cement on the top of all, the charge

being given a couple of turns dry to shake down all of the batch, the water then being added to make it of a consistency that would not flow but would cone up in the bucket, a small amount additional water being added at the dumping platform to bring it to the required mushy mix. If mixed as wet as it should be the concrete flowed into a solid set mass in the bucket, due to the joggling while being run out on a steel track in a steel car, and would have to be dug out of the bucket on reaching the dump. The concrete was dumped into chutes having a hopper top and a narrow throat and was distributed in the forms by means of shovels and hoes. In the buttresses the concrete was dumped on both sides of the track, long or short-necked chutes being used, depending on the place the materials were to be put, shoveled into place and the spade tampers used along the walls. In the narrow forms the concrete was distributed to the final place as nearly as possible and leveled off with hoes, being pried away from the walls by the spade tampers. Some fragments of one-man stone were placed in the buttress walls but as the stone supply was on the same side as the concrete plant, the interference of the gangs made it of doubtful economy to put in the stone except where the interference did not take place.

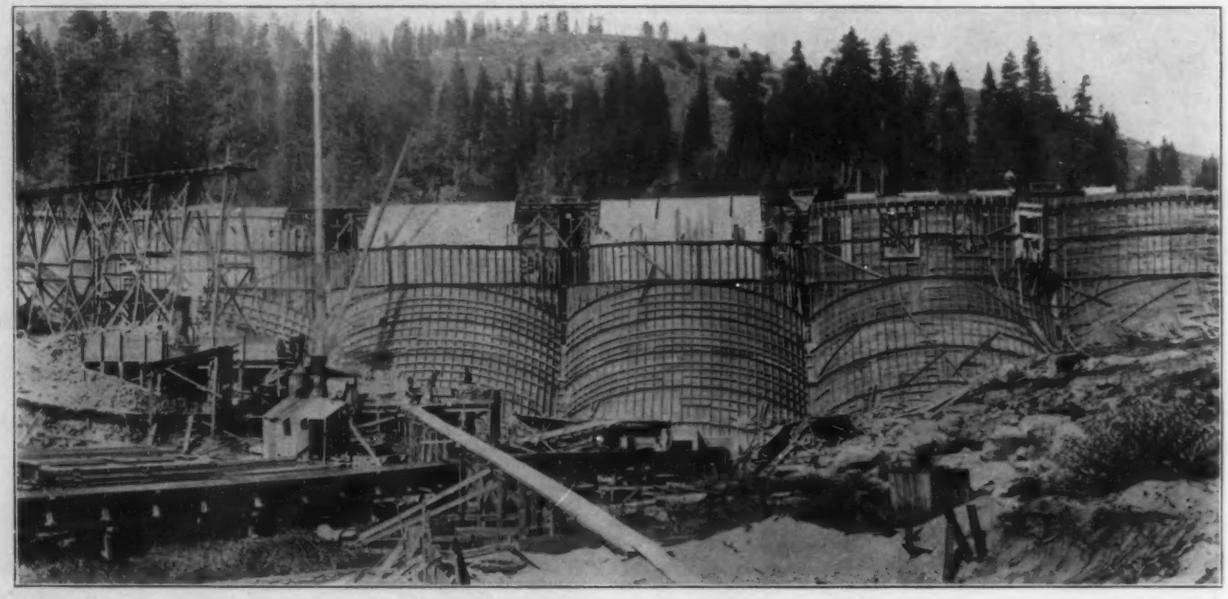
The forms were not removed for at least a week after the concrete was laid and the walls were kept wet by a night watchman and the day crew.

A union of the different days' work was made by scarifying the surface of the old work, sweeping up and shoveling out the loose fragments and washing off with a hose, dry cement was then sprinkled over this surface and concreting begun, a few batches of concrete with excess of mortar being laid in contact, the work being carried up as nearly level as possible. The junctions of the walls were made on the center of buttresses, the reinforcement being left protruding to tie them together, the old work being in each case scarified and washed before the union was made.

The water face and parts of the downstream face were plastered, the water face with two coats of 1 to 1½ cement plaster and selected sand and a wash coat of neat cement on the bases of the middle arches.

A base seal of mortar was placed along the line of contact with the rock to seal any possible opening at this point. To prepare the walls for the plaster they were scarified with a pick, then thoroughly washed with water and the plaster applied. An experiment was made with silicate of soda for the purpose of ascertaining its value in making the plaster adhere to the walls and was found to make it stick under the most trying conditions, as a rainstorm occurred in the night following the test, washing furrows in the wet plaster, but it was adhering as firmly as if it were part of the concrete instead of the fresh plaster coat.

The reinforcement consisted of old logging cable and was freely used, about 7½ miles in all being in the structure, and where bars were needed railroad iron scrap was used. The buttress walls were reinforced with cables run horizontally through them near their edges, not because these walls would be put to tensile stress, but to tie them to the later built arch ring walls. For this reason many of these cables were short and some were loops with their ends protruding.



View From Sand Pit Showing Plant, Forms and Chute.

The arch rings were provided with a cable for each square foot of area of the end section, these cables running horizontally and extending from end to end of the arch ring and into the next or into the buttress wall. The only tensile stress that can occur in the structure would be a shrinkage stress, but as the closure was made in the winter these do not exist, the reinforcement being to prevent a crack from any cause. Bars were placed on end in the foundations of the buttresses and the arch rings, and were placed about all of the openings. Two of these bars were placed across the bottom of each spillway opening, one acting as a lip at the downstream edge to protect the concrete, the other being between the two vertical bars that form the slide for the weir boards. Two bars

were also placed across the top of each spillway opening to stiffen this part of the wall.

As the dam was standing empty from November, 1908, to June, 1909, it was subject to the severest strains it will probably ever get and as an index of its proper design it has no sign of a crack in it.

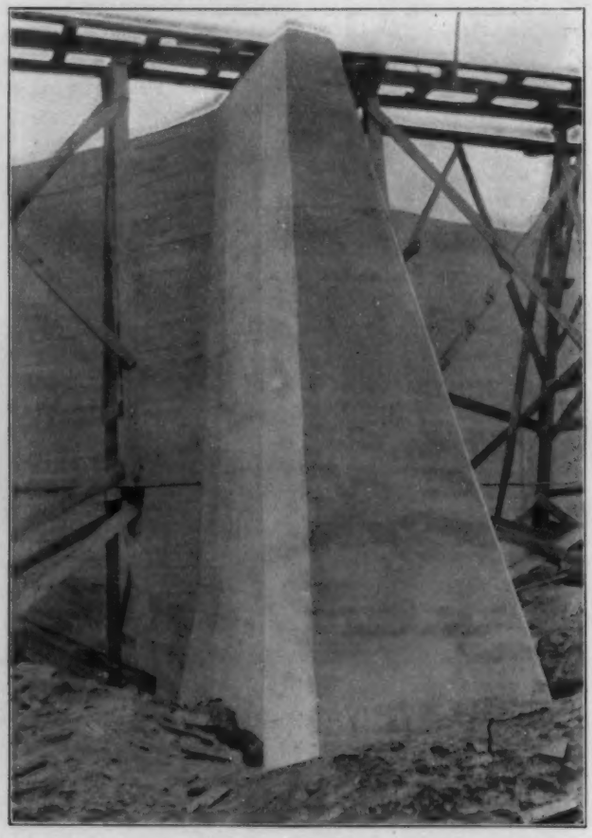
The arched openings that were left to allow the winter freshets to pass were closed during the first week in June, 1909, and the reservoir filled as fast as the stream could fill it. A very small amount of seepage passed through the last plug used in making the final closure, which soon ceased and the dam is practically bottle tight.

End of Buttress, Showing Cable Reinforcement to Tie Buttress to Arch Walls.

Three outlets are provided, one of 24 in. diameter for drawing off the water at low stage to clear the pond of logs, and two of 12 in. diameter for the discharge of water to supply the flume, these latter being both at a higher elevation than the main gate and one higher than the other. They are all provided with screens made of railroad bars set in concrete boxes in which is located a flap gate of wood to be used in case it is necessary to remove the valve gate for repairs, the flap gate preventing the outflow of water in quantity meantime. When the valve is replaced the flap is again raised out of service.

A short length of pipe about 10 feet long is laid in the wall and a pier built over the part that projects out at the downstream side, the flange of the pipe protruding enough to allow handling the gate bolts. These pipes were asphalted but the asphaltum was all removed from the parts buried in concrete on the outside, the metal being given a roughing by cutting barbs with an axe on the outside about 2 inches apart, the cuts forming a scale pointing downstream and making an absolute bond with the concrete. These pipes were set in the concrete and are an absolute fit, there being no sign of seepage around them, contrary to prediction. They were swung by means of wires till the soft concrete was laid past the middle and then settled to place in it by cutting the wires and ramming them down, completing the laying over the top.

The spillway openings were placed in the middle three arches, as the ends of the structure were to be occupied by the mill on one end and the machine



Finished Buttress.

shops on the other, 12 openings, each 5 by 8 feet, were formed by carrying downward the cornice wall to form a frame projecting on the upstream side. Into this a slot for the weir boards was made by setting two railroad irons flange to flange, tied into the wall by means of rods through holes in the web at the top and set in the wall at the lower end, serving the double purpose of a stiffener for the wall and for a permanent slot for the weir board gates.

The effect from an artistic point of view is also pleasing, there being a harmony with the remainder of the structure. There will be no wear of the rock at the outfalls, as the water only spills for a short time during each year and then is clear water in a small quantity at each opening. The granite bedrock on

which it falls is hard and sound and will withstand the wear of the water for an indefinite time.

From this brief description it will be seen that this structure is built on an entirely new design as to the water face and for that reason is the most flexible of any type of hollow dam, as it may be adapted to any site for any height, and will in all cases be the cheapest and best structure, where permanence must be considered, for any height at any site. It is particularly adapted to use for high dams as its true merits then become more positively in evidence, the water face being the part of a buttressed dam where any saving in cost or gain in efficiency must be found, the buttresses being the same with the same stresses in any design, though there is quite a saving in the buttresses in this type due to the flexibility as to span, thickness and form work.

The structure is 677 feet long on the center line of the crest, 51 feet high above its toe at the water face and 61 feet at the center line, closing an opening of 17,140 square feet of area at a cost of $2.68 per square foot, contains 2207 cubic yards of concrete and was built in 114 working days from the time the surveys were made.

The structure is all in direct compression, whether empty or loaded, the maximum being in the bases of the arch rings, where it is 13.5 tons per square foot, or 187.5 lbs. per square inch, giving a safety factor of 16, counting 216 tons per square foot, or 3000 lbs. per square inch, as the ultimate strength of concrete. The maximum stress in shear is 3.6 tons per square foot, or 50 lbs. per square inch, or at a shearing strength half of compressive, a safety factor of 30, the load on the base is 4.95 tons per square foot, all evenly distributed when full loaded over the base area. The ratio of the overturning moment to the moment of stability is as 1 to 3.6, the resultant thrust line cutting the base at the center of resistance of the base. There is no unbalanced loading, and the angle of the resultant is such that it exceeds the angle of friction between masonry and masonry. Hence the structure would not slide if set loose on its base.

Front of Dam, Filling Pond and Detail of Spillway Gate Openings.

As the walls are over strong at all points above the base, the stresses running to zero at the water line, the safety factor of the walls at all points is in excess of that at the base. The necessary thickening of the top walls is the reason why the type is even more economical for high structures, the percentage of over-strong wall decreasing as the height increases. As the quantities are increased for the increased water pressures only, and the stresses are all in compression and all balanced, the only limit to which this type is subject is the one of economy of the development.

If a structure of this type be built with the economy of materials that would result from the use of stresses such as are used in other structures, using a compressive loading of say 500 lbs. per square inch, it can be built at any site cheaper than any other structure to close an equal area, except small structures for temporary use.

Detail of Arch Form Construction.

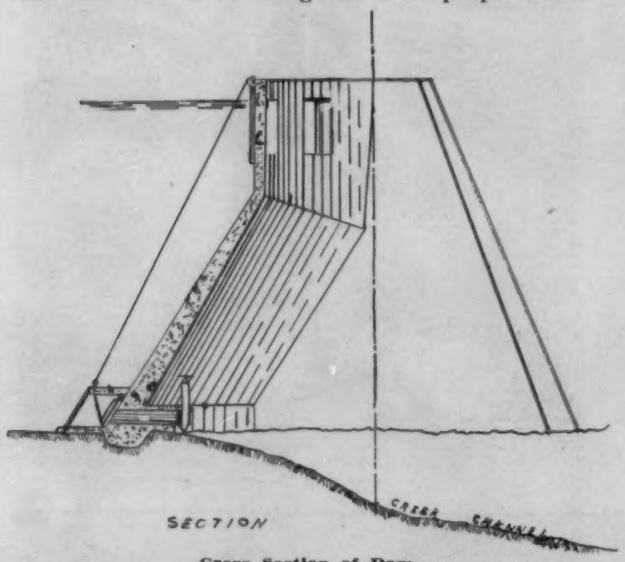
The cheapest other structure that could have been built at the site of the Hume Dam would have been a rock-fill and timber face dam, the estimated cost of which was $74,000, with all the uncertainties as to safety and water tightness, while for 61 per cent of that cost a dam has been built with higher safety factors than are to be had in any solid masonry dam, bottle tight, and as permanent as the cliffs of the great Kings Canyon upon which it faces.

The work on the final location surveys was begun on the 26th of June, 1908, the concrete work was begun on the 20th of August, and the last concrete was laid on the 27th of November, the working time being 114 days. The cost including the plastering was about $21 per cubic yard, or $46,000 for the structure.

The cement cost a little over $5 per barrel delivered at the site, it being hauled 45 miles, from Sanger to

Millwood, then loaded on the lumber cars, hauled to and up the hoist, again unloaded and hauled over a bad road to the site, the frequent handling resulting in a considerable loss by sifting and added expense of haul. Lumber for the forms was charged to the structure at $10 per 1000 feet at the yard; common labor was from $2.25 to $2.50 per day, skilled labor $3 and carpenters $3.50 per day. The structure has been in service since June, 1909, and is entirely satisfactory in every way to the company.

The foregoing description applies to the Hume Lake Dam, which is a modification of the type to suit the site, the long spans being used in order that the materials used could be given their proper stresses



Cross Section of Dam.

for the thickness of wall required for water tightness and for constructive requirements. The type is adaptable to any condition where a dam may be required, the dimensions of the various members being varied to suit the conditions met, whether overflow or not. There being no tensile stresses in it and only a nominal amount of reinforcement, it can be given a higher safety factor for less cost than any other type of structure for the purpose, and will therefore become in time, when its merits are fully understood, the standard structure for dams at all places where the materials can be had for concrete within a reasonable degree of cost.

The Hume Dam was built under many adverse circumstances as to appliances and great cost of materials due to long haul, but with all these it has been shown that it cannot be touched by any other type of dam of a permanent nature, in cost, in permanence, in freedom from upkeep charges or in the safety against destruction from any cause, as permanent as the hills and a part of the geology of the earth.

Governmental hydro-electric plants have been built in connection with the Strawberry Valley irrigation project in Utah and the Roosevelt dam in Arizona. Secretary of the Interior Ballinger has approved a contract whereby the U. S. Reclamation Service will furnish electricity for lighting Spanish Fork City at a cost of eight-tenths cent per k. w. hr. Power is also being supplied to light Phoenix, Arizona.

PORTOLA ILLUMINATION.

Electricity played a leading part in the Portola Festival, October 19-23, during which rebuilt San Francisco hospitably welcomed many visitors. The principal thoroughfares and buildings were brilliantly illuminated each night of the celebration, and on the last evening the brilliant pageant included a number of electrical floats, surpassing any of their kind yet built.

Due credit has been given to the committees having in charge this as well as other features of the celebration. But there is one man, who for unselfish devotion and self-sacrificing efforts, should receive a great meed of praise for the world-wide recognition

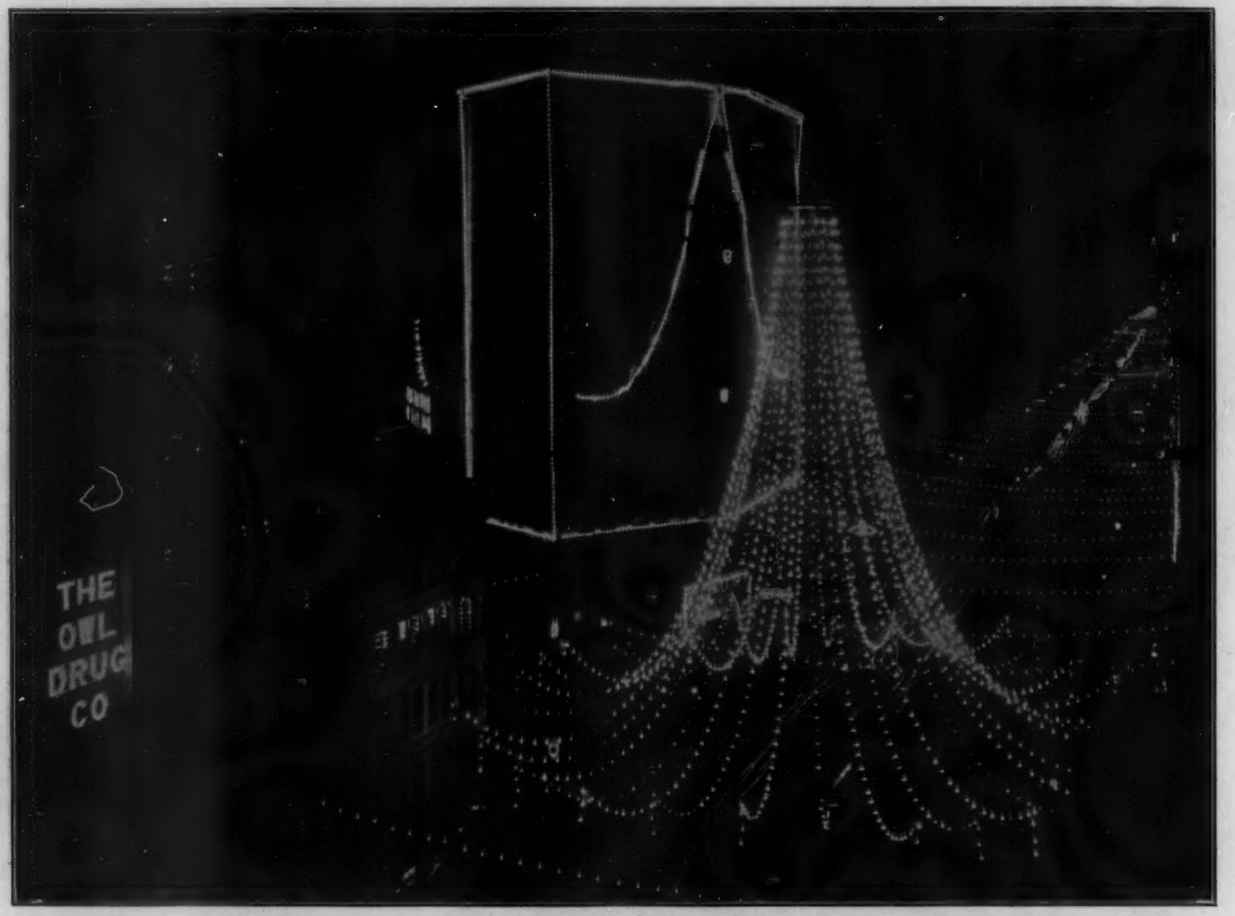
Photo by Brunner-Bach Co.

Electric Bell at Third and Market Streets

of the festival and its purpose. Charles C. Moore, visited the principal countries of the world, obtained orders for war-ships to visit the harbor of San Francisco at this time and proclaimed to the world the stability of the resurrected city.

The spectacular lighting radiated from a great bell at the intersection of Market, Kearny and Third streets. This bell contained two thousand 16 c. p. incandescent lamps, and rose to a height of 125 feet above the street. The central supporting platform, 2000 pounds in weight, was suspended by cables, a span of 180 feet, from nearby buildings, and from it, festoons of lamps were carried to a lower ring 120 feet in diameter, consisting of ¾-inch galvanized strands placed 40 feet above the street level. The feeders were 500,000 circular mil cables fed from the street circuit 110 volt 3-wire system. A like bell at the intersection of Third and Townsend streets, consisted of six hundred 16 c. p. lamps. Lights were strung at regular intervals across the street throughout the length

View on Market Street and Colonnades at Ferry Building *Photos by Brunner-Bach Co., 47 Kearny St., S. F.*



View on Market Street

of Market and the principal intersecting streets, as may be seen from the accompanying photographs. The Ferry Building, at the lower end of Market street, was brilliantly outlined and fronted by electric colonnades. Fillmore street was also similarly illuminated between Fulton and Sacramento streets, and the existing arches alternately supplied with red and yellow globes, sixteen hundred 8 c. p. lamps being used. Most of this work was done by the Standard Electric Construction Company, and it is noteworthy that it was accomplished without accident and that there were no broken lamps. The McFell Electric Works, The Latchem Engineering & Electric Company, Inc., and the Butte Engineerings Works also did considerable of this work.

The St. Francis Hotel, in addition to being brilliantly outlined as illustrated in a former issue, was surmounted by a gigantic American flag, constructed so as to give the rippling effect of a flag in the breeze. Many of the large stores of the city, including Lilienfeld's, as illustrated herewith, Roos Brothers, the White House, the Emporium, and others, were likewise illuminated.

The electrical floats in Saturday night's celebration were symbolical of scenic California. They included one of the falls of the Yosemite with running water brilliantly illuminated by 1200 lights. Shasta and Mossbrae Falls were similarly re-produced. The Santa Barbara Mission, within whose arbor an electrical fountain played, was outlined in thousands of

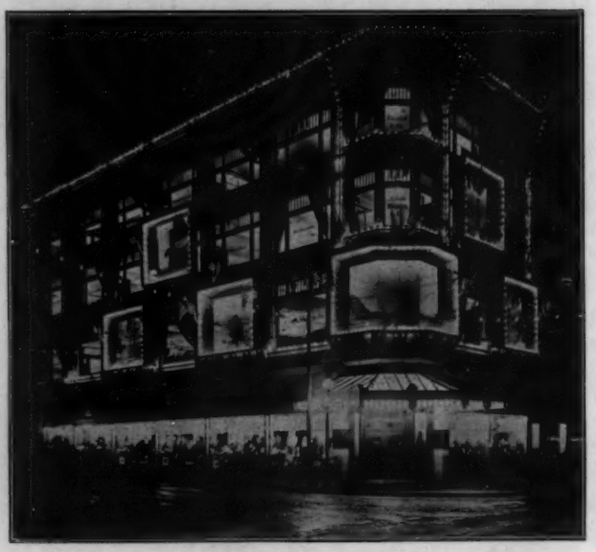


Photo by Brunner-Bach Co. **Lilienfeld's Store**

colored lights. A huge redwood log, apparently hauled by two horses, was beautifully brought out by electric lights. Thousands of colored lights and Chinese lanterns were used to advantage on a float representing Chinatown. The electric fountain was a prominent part of the float representing Miss San Francisco. Another float containing 1500 frosted lights represented Cook and Peary at the North Pole.

SOME THINGS ABOUT STEAM.[1]

BY W. F. DURAND.[2]

Steam is known to the engineer through its properties or characteristics. Of these there are five of chief importance, and to these the discussion of the present brief article will be restricted. These characteristics are pressure, temperature, volume, quality and energy.

Pressure.

Steam in common with all vapors and gases exerts a pressure on the walls of any containing chamber, such as a boiler drum or steam cylinder. According to the molecular theory of matter, this pressure is the result of a bombardment to which the walls of the chamber are subjected by the flying molecules of the vapor or gas. If we could imagine, say, one hundred men throwing a stream of baseballs at an average rate of one a second for each man, and suppose these baseballs to land on a target, say, three feet square, then such a series of impacts would develop a very considerable force acting on the target in the way of a pressure. In a somewhat similar manner the walls of a chamber containing a gas or vapor are supposed to be bombarded in all directions and in every direction equally, and thus is developed the characteristic we call pressure. The pressure is reduced to numerical measure by taking the total force thus acting on a unit area and calling this the intensity of the pressure, or, more briefly, the pressure. The actual units employed are the inch and pound or the foot and pound, the former giving us the pressure in pounds the square inch and the latter the pressure in pounds the square foot. In all ordinary specifications and for all purposes of everyday use the square-inch unit is employed.

On the surface of the earth we live, move, and have our being in an atmosphere which is itself a gas having an average pressure measured at sea level of about 14.7 pounds the square inch. All operations of the engineer are carried on surrounded by this atmosphere. It is present everywhere, except when specially and carefully excluded. In particular, all ordinary pressure gauges and instruments for measuring pressure are surrounded by the atmosphere and exposed to its pressure. This means that the ordinary pressure gauge which is used for measuring steam pressure is in reality exposed to the pressure of the steam on one side of the elastic tube or diaphragm, and to the atmosphere on the other. It follows that the steam on its side must produce a pressure of 14.7 pounds the square inch in order to balance the pressure of the atmosphere, and in order to put the gauge in the condition in which it was made in the shop, with, of course, the atmospheric pressure on both sides. Hence the movement of the gauge pointer upward will not begin until this pressure of 14.7 pounds has been reached by the steam, and what the gauge pointer measures is really the excess of the actual pressure over the atmospheric pressure or starting value of 14.7 pounds.

The pressure as read from a gauge is called gauge pressure. The total or real pressure of the steam is then greater than this by the pressure of the atmosphere or by 14.7 pounds. This total or actual pressure is called absolute pressure. Absolute pressure is therefore found by adding 14.7 pounds (in round numbers 15 pounds is often employed) to the value of the gauge reading.

Temperature.

When water is heated under any constant condition as regards pressure it is found that vapor is not formed until the temperature of the water rises to a certain value depending on the pressure, and that when such value is reached, then the further addition of heat results simply in the formation of water vapor or steam, without further rise of temperature so long as any water remains in the liquid state. Conversely, in any such condition the abstraction of heat will result in a partial condensation of vapor back into liquid, the temperature meanwhile remaining unchanged. The temperature at which water may thus pass back and forth between the condition of vapor and liquid by the addition or removal of heat, the temperature and pressure remaining constant meanwhile, is called the temperature of the stream. It results that for each value of the pressure there is a particular corresponding value of the temperature or for each value of the temperature there is a particular corresponding value of the pressure.

This relation between pressure and temperature is not one which can be satisfactorily expressed in algebraic form, though various attempts at such expression have been made. Every engineer should, however, have in mind the general character of the relation. Thus at very low pressures the rise in temperature by pound increase in pressure is very rapid. Between one pound and fifteen pounds absolute the temperature rises from 102 to 213 degrees, or through a range of 111 degrees, an average of about 8 degrees a pound. At the upper end of this range, or about atmospheric pressure, the rise in temperature is about 3.5 degrees a pound. At 28 pounds absolute it has dropped to 2 degrees a pound, at 66 pounds absolute to 1 degree a pound, at 160 pounds absolute to .5 degrees a pound, and at 212 pounds absolute pressure to .4 degrees a pound. It results that a few pounds change at such pressures as are met with in modern steam plants results in a much slower rate of change in temperature. On the other hand, a change of very many degrees temperature at the lower end is required in order to produce a change of a single pound in pressure. Thus from 2 pounds absolute to 1 pound the drop is about 25 degrees. These facts have an important bearing on the difficulty of increasng the vacuum from the values of 25 or 26 inches which prevailed some years ago up to the 28 and 29 inches demanded by the best practice with steam turbines at the present day. From 26 inches vacuum to 28 inches means about the same in cooling effect as from no vacuum to 18 inches.

Volume.

By the volume of steam we mean the volume occupied by one pound. This is always measured in cubic feet, and is found to decrease continuously with the increase of pressure and temperature. The relation between pressure and volume is likewise too complex for expression in algebraic form, at least with any high degree of accuracy. A very crude thumb rule relation is the following: The product of the pressure in pounds to the square inch absolute by the volume in

[1] Pacific Gas and Electric Magazine.

[2] Professor of Mechanical Engineering, Stanford University.

cubic feet equals 440. Between pressure of 50 pounds and 200 pounds the error in this will not exceed 5 per cent. It is sometimes convenient to have in mind a roughly approximate rule of this character.

At low pressures the volume of a pound of steam enormously increases. Thus at 100 pounds absolute it is 4.4 cubic feet, at 15 pounds absolute it is about 26 cubic feet, at 10 pounds it is about 38 cubic feet, and at 1 pound 335 cubic feet. This fact has an important bearing on the difficulty of realizing expansion to low values of the terminal pressures in the cylinders of a reciprocating engine, and furnishes the basis of one of the relative advantages of the turbine, by reason of the comparative ease with which such large volumes are handled and the corresponding low terminal pressures realized with the turbine form of prime mover.

Quality.

Steam as actually generated in all boilers is liable to carry with it in the form of a fine mist or spray a certain amount of water in the liquid condition. When steam escapes into the air it is the mist or finely divided spray thus formed by partial liquefaction that renders the steam visible. Water vapor without liquid admixture is as colorless and invisible as air, and the visible part of steam, so-called, is not vapor but water in the form of a finely divided mist. The proportion of water which the steam may thus carry determines the so-called quality of the steam. It is usually measured as a percentage, the figure denoting the fraction of the total which is in the form of actual pure vapor. Thus 94 per cent. quality means moist steam in which 94 per cent. by weight consists of actual vapor and 6 per cent. by weight is water in a more or less finely divided state. Pure water vapor without admixture of mist or liquid water and at the same temperature as moist steam of equal pressure, is known as dry saturated steam. This condition evidently corresponds to 100 per cent. quality. Good steam boilers should furnish steam with not more than 1 to 3 per cent. moisture; that is, with a quality of .97 to .99, and under the best conditions these values may be improved somewhat. But it is practi cally impossible to obtain steam without some moisture when drawn directly from a boiler drum containing in its lower part a body of water in more or less active agitation and liberating steam at its surface.

If steam of ordinary quality be taken away from contact with the water from which it was formed and at the same constant pressure be subjected to still further contact with a heating surface, then it will absorb additional heat, the last remnants of moisture will be vaporized, and from the instant this condition is realized the temperature will begin to rise and the steam will pass into what is known as the superheated condition. Superheated steam is therefore steam with a temperature higher than that corresponding to the formation of saturated steam of the same pressure. The amount of superheat is measured by the number of degrees excess of temperature thus contained. In modern steam turbine practice the amount of superheat may vary from 100 to 150 degrees or higher.

Energy.

The energy possessed by steam is usually measured from the temperature of melting ice as a convenient datum. Steam possesses energy as a result of the input of heat in the process of its formation. The input of heat required to transform one pound of water at 32 degrees F. into dry saturated steam at any temperature is not, however, quite the same as the change of energy between the same two conditions. This is because the heat which is required to produce such a change of condition really does three sorts of things or is divided into three kinds of energy before it is finally stored away. One part makes the body hotter. This represents an increase in molecular kinetic energy and remains within the body as a part of the increased store of energy. A second part overcomes external pressure during the process of vaporization and while the temperature remains constant. This external pressure is represented by the pressure required to control and contain the steam as formed. This work or its equivalent energy is not stored up within the steam at all. It is work performed against a resistance external to the steam itself, and as such produces an external result, and its equivalent energy or result, whatever it may be, is not manifest within the steam. This portion of the heat is not therefore stored within the steam and does not represent any part of its increase of energy.

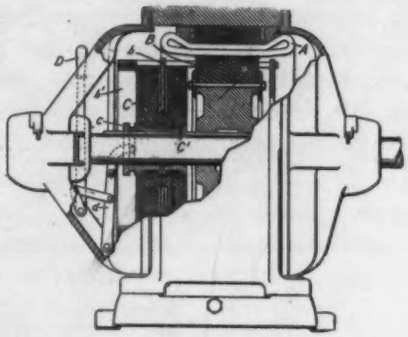
A third part of the heat during the process of vaporization is used in performing work against an internal resistance. The water molecules are pulled or forced apart against a force many times greater than that represented by the external pressure, and the heat energy required to perform this internal work is stored up within the steam as its potential energy. The total energy of steam is therefore in part kinetic, corresponding to the increase in temperature, and in part potential, corresponding to the work performed against internal molecular forces.

As the pressure of steam is carried higher and higher the kinetic energy continuously increases, the potential energy slowly decreases, and the total energy undergoes a slow increase.

The so-called total heat of steam is not properly speaking a characteristic. It is the heat flow into the body which is necessary in order to transform one pounds of water at 32° into steam at the stated pressure and temperature, and supposing that the water is carried along a definite path of change consisting first of a rise of temperature and pressure without vaporization until the temperature and pressure corresponding to the stated condition is reached, and then a change of state from liquid into vapor at constant temperature and pressure until the liquid is completely transformed into dry saturated vapor. This is a particular path of change and the heat input along this path is called the total heat of the steam. Such a program corresponds closely to that actually followed in a steam boiler, and hence such values of the total heat are of use in dealing with the usual run of power-plant problems. It may be of interest to note, however, that by varying the path of change the heat input required to form one pound of steam from water at 32° may be made to vary between wide limits, so that the expression "heat of steam" has no meaning aside from the particular path along which the substance is supposed to be carried in passing from the initial to the final condition.

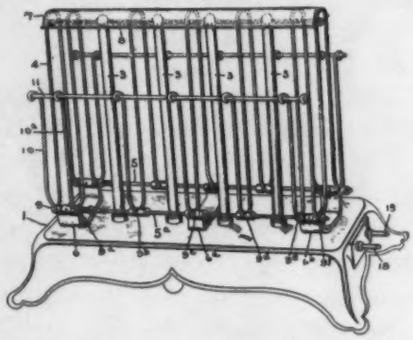
PATENTS

936,292. Induction-Motor. Sven R. Bergman, Lynn, Mass., assignor to General Electric Company. An induction motor having a stationary primary winding, a secondary rotor winding of the squirrel-cage type having a high resistance end-ring



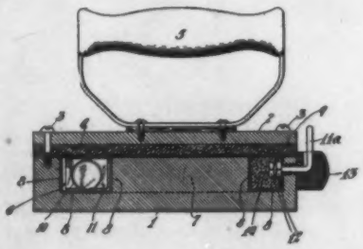
and a low-resistance end-ring in parallel at one end of the secondary conductors, a laminated magnetic body carried by the rotor, and means for moving said body toward and away from said low resistance end-ring.

936,597. Electric Toaster. William S. Andrews, Schenectady, N. Y., assignor to General Electric Company. An electric cooking utensil, comprising a plurality of electric heaters adapted to be operated at a radiant heat and sur-



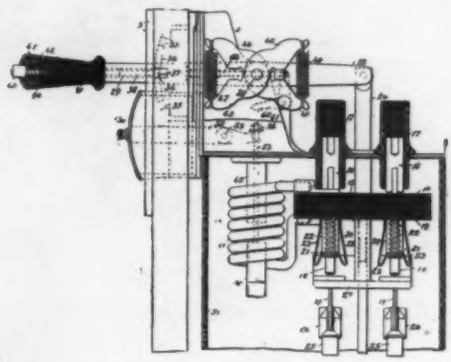
rounded by an open-work casing having a plurality of supports for material to be heated, whereby the radiant heat from the several units may be applied simultaneously on two sides in view of the operator.

936.556. Electric Laundry-Iron. Harry C. Newman, Los



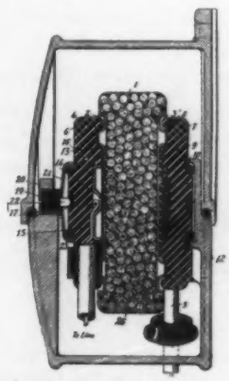
Angeles, Cal., assignor of fifty-one one-hundredths to J. J. Jenkins, Los Angeles, Cal. In an electric heating utensil, a body having a channel forming a wedge shaped core, insulating material lining the walls of the channel, a heating element removably fitting in said channel comprising a coiled wire, and insulating coil spacers between the respective coils of wire, the turns of the coil of wire and the insulating spacers substantially fitting within the lining in the aforesaid channel and retained in place by said lining, and terminals at the rear end of the body, the respective ends of the coiled wire being attached to the terminals.

936,578. Electric-Circuit Interrupter. Harve R. Stuart, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. In a circuit interrupter, a tripping device comprising a stationary core member, a movable core member,



a hammer rod attached to said movable member and screw-threaded near its free end, a nut on the screw-threaded portion, a lever one end of which engages said nut, and a calibrated dial having a slot through which said lever extends.

936,656. Electrical Discharge Apparatus. Newitt J. Neall, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. The method of forming blocks or plates for electrical discharge devices, which consists in forming con-



ducting material into pellets, coating the pellets individually with insulating material, hardening the insulating coatings, binding the coated pellets together in a plastic insulating material and hardening the insulating binder.

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Recognition of Engineering

Through common usage the term "engineer" has been so extended as to embrace those engaged in a large number of diverse occupations. Every line of human activity requiring special knowledge of materials, machinery and the laws of mechanics has its engineers. As a consequence, the name "engineer" has been assumed by many not possessing the necessary qualifications. Even an ordinary advertising man rises to the dignity of engineer of publicity. Such indiscrimination and unauthorized use of this title tends to lower the standing and cast discredit upon an honorable profession. The name "electrician" has been thus degraded until to-day it means merely a plumber.

To correct this abuse, many remedies have been suggested. Among the most radical is that advocated by Mr. G. A. Thomas in a paper entitled "Status of Engineering Profession," which was recently read before the British Society of Engineers, and was awarded their prize. The author suggests the compilation of a register to which no one shall be eligible who is not a full member of one of the three leading British engineering societies and at least an associate of one of the others. Furthermore, that anyone not thus registered should be legally disqualified from receiving fees as consulting engineer, and debarred from holding any public engineering appointment.

While this proposal is beautiful in theory and might receive endorsement in the British Isles, its practical enforcement in this country could be more productive of trouble than is the evil that it seeks to remedy. To empirically create an artificial aristocracy is but to invite jealousy and dissension, which would ultimately defeat its primary purpose, that of gaining recognition for the engineering profession as a whole.

Recognition, like confidence, is a plant of slow growth. Not only must a man live with his work, think with his work, eat and sleep with his work, but he must accomplish something before he is recognized. He may be said to be successful when his name and his specialty becomes synonymously and reversably interlinked. Recognition is individual, and that profession having the greatest number of individual successful members is correspondingly accorded the greatest recognition. The legal profession, as a whole, stands high, but who is held in such contempt as a shyster lawyer. The medical profession receives recognition, yet there are doctors who are refused the privileges of the United States mail. But that engineer who works quietly and steadily to accomplish some definite purpose will, in time, do more to advance the status of engineering than any number of registers.

CURRENT COMMENT

Water motor washing machines are estimated to consume water worth from $9 to $10 a year at a 25-cent rate in a family of six persons.

Renewing tungsten lamps can be sometimes effected by welding the broken filament. This may be accomplished by gently agitating the filament while the current is turned on, until the broken ends touch and unite.

Air nitrate fertilizers, methods for the fixation of nitrogen by electricity, as accomplished in Norway and Sweden and at Niagara Falls, are described in a report from the Bureau of Manufacturers, U. S. Department of Agriculture.

The visibility of light at great distances depends largely upon its wave length. Thus the bluish green light from a mercury arc lamp can be seen much further than a yellow or red light. In a heavy fog, however, this is apparently reversed, for a yellow light has been observed to have better penetration.

The harmful effects of artificial light, as compared with daylight, is explained by Steinmetz as due largely to the preponderance of low frequency vibrations, most of its energy consisting of the ultra-red and invisible rays, which contain greater power and cause smarting and irritation due to "power burn."

The spectrum of radiation covers a range of nearly sixty octaves, of which less than one octave consists of visible light rays. In order of frequency these extend from the alternating current, through the various high frequency electric currents, wireless telegraphy and Herztian waves into the infra-red, the visible light and the ultra-violet rays to the X-rays. The corresponding range of sound waves is nine octaves.

A tunnel driving record has been established by the builders of the Red Rock tunnel of the Los Angeles aqueduct who advanced the work 1,061.6 ft. during the month of August. This is an average of 35 ft. per 24 hr. day, there being three eight-hour shifts. This tunnel is 35 miles north-east of Mojave, California and was driven through soft sandstone at a cost of $6.41 per ft. or $1.67 per cu. yd. No timbering was necessary.

Electric smelting of steel from iron ores direct has been accomplished at Dommaldingen in Luxomberg, Germany. Notwithstanding that the ores are low grade and contain a high percentage of phosphorus, the steel is said to be as fine as that obtained from the best Swedish ores. The electric furnace employed is the invention of Ruchling and Bodenhauser. The beneficial influence of this advance is summarized in a bulletin from the American Association of Commerce and Trade at Berlin.

A permanent magnetic metal is described in a patent recently granted to Samuel E. Gertler of New York City. Its principal components are tungsten steel and aluminum in the following proportions: tungsten 5.25 per cent, carbon .65 per cent, silicon .15 per cent, manganese .25 per cent, chromium .20 per cent, sulfur and phosphorus .02 per cent or less, aluminum 2.50 per cent, and iron to an amount providing 100 per cent in all.

Killing Moths in Vineyards by Electric Lights is reported from Rheims, France. The trap consists of a portable post holding a 5-candle electric lamp with an enameled reflector, from which, attached to 3 thin metal chains about 8 inches long, is suspended a round tin-plate dish of about 15 inches in diameter. The dish contains water with a top layer of petroleum. The moths swarm toward them and are rapidly killed, either by the fumes of the coal oil or by the coal oil itself. These experiments were witnessed by representatives from a number of leading champagne makers, and this method proved so successful that it is highly recommended to all wine growers who can avail themselves of the services of electricity for this work.

The production of coal in California in 1908 was 18,755 short tons, having a spot value of $54,840. California is not an important coal-producing State, but it is one of the few in which the output in 1908 showed an increase over that of the preceding year. All of the production was the result of recent developments in new territory. The old mines at Tesla, in Alameda County, and at Black Diamond, in Contra Costa County, were idle throughout the year. The recent developments have been at Ione, in Amador County, and at Stone Canyon, in Monterey County. The production in those two counties in 1908 exceeded that of 1907 by 4805 tons, and the increase in value amounted to $16,627. The coal-mining industry of California has been adversely affected, first by the importation of foreign and better coals, brought largely as ballast, and, second, by the increased production of petroleum and its use as fuel in manufacturing establishments. Up to the close of 1908 all the coal mined in the State had been of the lignite or subbituminous variety. During the last year, however, the development of the mines in Stone Canyon, Monterey County, has placed on the market a bituminous coal of a quality adapted to compete with the foreign coals brought into the San Francisco market, and it is believed that this will result, to some extent, in the rehabilitation of the coal-mining industry of the State.

PERSONALS.

H. M. Lauretzen of the Holophane Company is in San Francisco this week.

Fred Hamilton, purchasing agent, Mt. Whitney Power Company, was in San Francisco during Portola week.

John Coffee Hays, manager of the Mt. Whitney Power Company, was in San Francisco during the past week.

S. Waldo Coleman, manager of the Coast Counties Light & Power Company, attended the Portola festivities last week.

Geo. H. Walbridge, president of the Central Colorado Power Company, is taking a brief vacation in San Francisco.

W. H. P. Hill, manager of the Monterey County Gas & Electric Company, was in San Francisco during the past week.

W. A. Jones, lighting superintendent of the San Joaquin Light & Power Co., was in San Francisco during the past week.

C. E. Barry of the railway department of the General Electric Company, Schenectady, N. Y., was in San Francisco last week

W. J. Davis, Jr., Pacific Coast engineer of the General Electric Company, returned last Saturday from a three weeks' trip in the Northwest.

Theodore Varney, engineer of the Westinghouse Electric & Mfg. Company, Pittsburg, arrived in San Francisco for a short visit last Saturday.

A. W. Smith, secretary of the Sacramento Valley Power Company, Redding, California, spent last week in San Francisco, visiting the Portola festival.

C. Remschel, who recently opened an office as consulting and contracting engineer at 118, Third avenue South, Seattle, was a visitor in San Francisco this week.

S. E. Junkin, president of the Westinghouse, Church, Kerr Company, with a party of engineers, was in Wallace, Idaho, recently, looking over the Thompson Falls waterpower proposition.

F. E. Case and H. N. Ransom of the railway department of the General Electric Company, Schenectady, N. Y., who are making a tour of the Pacific Coast, spent a few days in San Francisco last week.

John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, returned from the Orient this week. In his absence Mr. Britton was elected a director of the American Gas Institute.

S. K. Colby, vice president Pierson, Roeding & Company, left on Saturday for an extended trip in the East, visiting the several factories represented by Pierson, Roeding & Company, on the Pacific Coast.

B. G. Lamme, chief engineer of the Westinghouse Electric & Mfg. Company, Pittsburg, is in San Francisco for a short visit as the guest of his brother, W. F. Lamme, district engineer of the Westinghouse Electric & Mfg. Company.

Wynn Meredith of Sanderson & Porter left on the 25th of October for an extended trip to British Columbia, in connection with the Jordan River water power development for the British Columbia Electric Railway Company in Victoria.

A. Geuslein, of A. Geuslein & Co. of Los Angeles, Cal., has returned from a European and eastern trip during which he made a study of existing conditions in the electric and gas lighting fields. While in New York he made arrangements to handle the western agency of the Stitvan electric arc lamp, a new lamp manufactured by the Stilwell-Van De Mark Co., which will be on the market January 1, 1910.

S. F. SECTION A. I. E. E.

The San Francisco Section of the American Institute of Electrical Engineers held its regular monthly meeting in the Home Telephone Company Building on Friday, October 29. A paper on "Some Phases of Transformer Regulation," by W. A. Hillebrand and S. B. Charters was read and discussed.

PACIFIC COAST TOUR OF MASSACHUSETTS STREET RAILWAY ASSOCIATION.

A large delegation of the Massachusetts Street Railway Association were in San Francisco during Portola week in the course of a tour of Pacific Coast cities. Among those in the party were: James F. Shaw, president American Street & Interurban Railway Ass'n; R. N. Wallis, president Accounting Ass'n; Paul Winsor, president Engineering Ass'n; Charles C. Pierce, vice-president Manufacturers' Ass'n; E. G. Connette, general manager Worcester Consolidated Street Railway Co.; H. C. Page, vice-president and general manager Springfield Street Railway Company; D. Dana Bartlett, auditor, Boston & Northern & Old Colony Street Railway Co.; John R. Graham, president Bangor Railway & Electric Co., and Lewiston, Augusta & Waterville Street Railway Co.; H. E. Reynolds, assistant general manager Boston & Northern and Old Colony Street Railway Co.; W. W. Sargent, superintendent Fitchburg & Leominster Street Railway Co.; E. P. Shaw, Jr., general manager Boston & Worcester Street Railway Co.; H. L. Wilson, treasurer Boston Elevated Railway Co.; Franklin Woodman, general manager New Hampshire Electric Railway; Fred J. Allen, secretary Atlantic Shore Railway; Thos. Hawken, superintendent Rockland, Thomaston & Camden Street Railway Co.; C. E. Learned, superintendent inspection Boston Elevated Railway Co.; M. H. Bronsdson, chief engineer The Rhode Island Co.; Senator Eben S. S. Keith; Thos. H. McCarter, F. H. Johnson, John Burns, Chas. O. Claire, J H Rollins, Geo. Nash, C. J. Thayer, C. A. Cook and Frank Coates, who together with the ladies, constituted a party of eighty. While in San Francisco they were entertained by Thomas Finnigan of the United Railroads and S. K. Colby of Pierson, Roeding & Co. On October 22d they left for Los Angeles.

TRADE NOTES.

The administration offices of the Electric Goods Manufacturing Company have removed from Boston to the company's plant at Canton, Massachusetts.

Carl Johnson, of the U. S. Electrical Manufacturing Co. of Los Angeles, has secured patents on a sewing machine motor which is to be manufactured by the company.

The General Electric Company report the sale of one C. C. 2 pole, 35 k. w., 3600 r. p. m., 240-250 volt turbine to Raphael Weill & Co., Inc., for lighting the White House.

A. L. Wilkinson, secretary of the Ohio Brass Company during a recent visit to San Francisco placed the Pacific Coast agency for his company's high tension insulators with Holabird-Reynolds Company, 523-525 Mission street, San Francisco.

The Sacramento Valley Power Co. have given the Allis-Chalmers Co. the contract for their whole transformer equipment. The Sacramento Valley Power Company is the merging company of the Northern Light & Power Company and the Shasta Power Company.

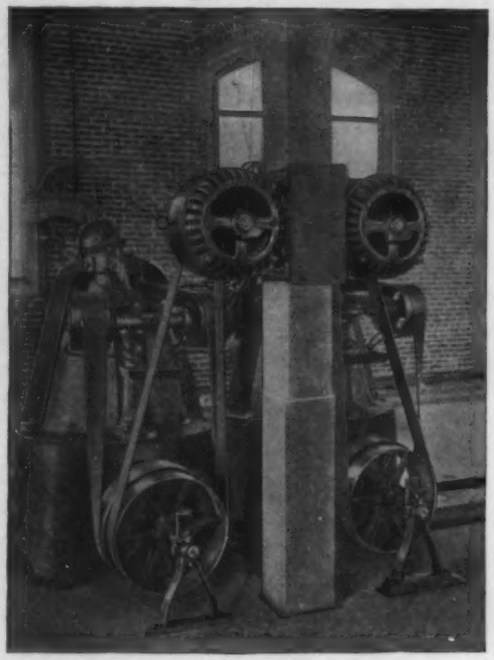
The General Electric Company report the sale of 2 C. C. 2 pole, 7 k. w. 5000 r. p. m., 120-125 volt turbines and one C. C. 2 pole, 20 k. w., 4500 r. p. m, 120-125 volt turbine, all condensing, for use on steam of 80 pounds pressure, and 27 inches vacuum, to the Union Iron Works for installation on the Monticello Steamship Company's new steamer "Napa City."

INDUSTRIAL

ELECTRICAL EQUIPMENT FOR MODERN LAUNDRIES.

Many people prefer hand laundries because, to the average person, machinery means dirt. This is largely true where the machinery is driven by shafts and belts. The belts wear on their pulleys, produce dirt and throw it into the air; oil drips from the shaft bearings, and even where drip cups are placed beneath to catch it, the oil dries up in these cups and is fanned into the air. Some oil often creeps along the shaft, and, being obstructed by the bearings, drops to the floor. Thus dirt lodges on the floor and on the clothes being laundried. A large number of the little spots and streaks of dirt which cause complaints from customers may be attributed in a laundry where line shafts and belts are necessary to such sources of dirt producers.

In the modern electrically driven laundry the conditions



Electric Drive Mangles in Quality Laundry

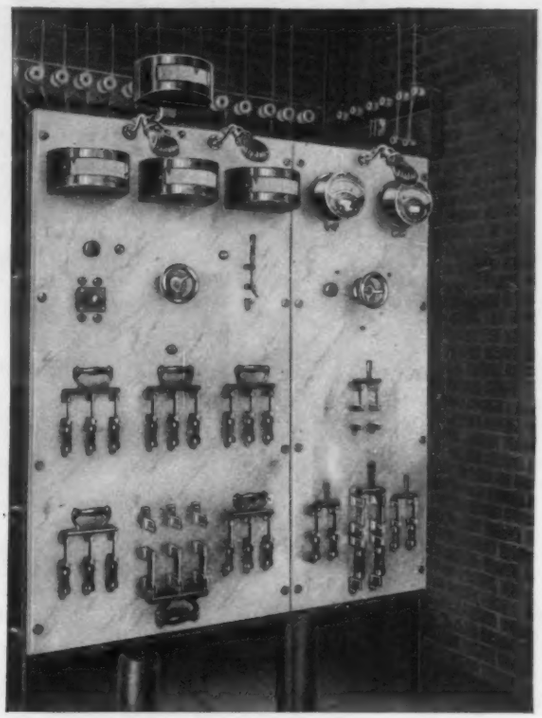
of the work rooms are quite different, because an electric motor drive produces a minimum of dirt. To such machines as mangles, the motors are geared direct. Extractors, washers, etc., as now built, demand a very short belt connection, but no external shafting is necessary. The motors are frequently mounted on the machines being driven or on convenient roof columns or walls. By such mounting the motors in no way interfere with scrubbing the floor or, if it be concrete, with flushing it with a hose.

Next to cleanliness, in the order of necessities for laundries, is good lighting. Every laundryman realizes this. A dark room not only makes good work difficult, but depresses the spirits of the employees. This point of spirit is now the cause of much thought on the part of experts on system and management. All agree that lighting is the largest factor in the problem.

Motor drive does away with the long overhead shafting and the belts which pass in front of the windows, casting shadows on the work and cutting off the light.

Besides this, the advantages of higher efficiency of power transmission for laundries, reliability of operation, and reduction of fire hazard due to motor drive, are as evident as for other industrial plants using power. One of the greatest advantages of individual and small group motor drives is that the power is literally put on "piecework." A machine is run when it is needed only. Power is paid for when the machine is working, and not when it is idle. If but one department has to work, the machines in that department only are run. It is not necessary to waste power turning over shafting throughout the building merely to keep two or three machines at work.

With motor drives the machines can be placed just where they are most convenient and where they will reduce the



Switchboard in Quality Laundry

amount of handling of clothes. They do not have to be lined up under a shaft. They can be placed anywhere.

As an example of the electrically equipped laundry, illustrations are here shown of the Quality Laundry, one of the largest and newest in Los Angeles. This laundry has recently been equipped with Hawthorn motors by the Western Electric Company, who have made a specialty of motor drive, and furnished, with the exception of a few small motors, the entire equipment. The Quality Laundry has its own generating plant, consisting of Western Electric Company's 3-phase, 60-cycle 220-volt generator.

Bulletin No. 4699, from the General Electric Company, is devoted to a description of a new type of motor-driven air compressor which eliminate to a large extent, at least, the objectionable features inherent in this type of machine. The bulletin will be of interest not only to railway men, but to all who have use for compressed air either in connection with railway or stationary work.

"Ever Ready" Exhibit at San Francisco Automobile Show.

ELECTRIC VEHICLES AT THE AUTOMOBILE SHOW.

An important feature of the Portola celebration was the annual exhibit of automobiles which was held in the Emporium Building, San Francisco. Among the exhibitors were the agents for three electric machines, and also the American Electrical Novelty & Manufacturing Company, who displayed the "Ever Ready" products, as shown in the accompanying photograph of the "Ever Ready" exhibit. It included taximeters, dry batteries, pocket flashlights, miniature lamps, Bulldog battery connectors, Plato clocks, electric clocks, speedometers, vulcanizers, auto starters, volt and ammeters, tire tools, vacuum bottles and tire pumps.

Rauch & Lang Exhibit.

Columbus Electric Exhibit.

The Columbus electric automobile was exhibited by the Bay Cities Electric Automobile Company of Oakland, California, who also added a small exhibit of "Exide" sparking batteries and parts.

The Rauch & Lang electric car was exhibited by McDougald Manufacturing Company, Twenty-second and Broadway, Oakland, California. A General Electric mercury arc rectifier was in regular operation, charging the car batteries.

Detroit Electric Exhibit.

The Detroit electric was exhibited by the Reliance Automobile Company of San Francisco.

All these cars are equipped with Exide storage batteries. The pictures are sufficient to show the attractiveness of each exhibit and no further description is necessary.

Frank Fowden Entertained Some Portola Guests.

Joseph Mayo, Manager Contra Costa Electric Light and Power Company, Martinez.
Wm. Knight, Allis-Chalmers Co., San Francisco.
W. A. Jones, Superintendent San Joaquin Light and Power Company, Fresno.
Frank Fowden, Manager Brooks-Follis Electric Corporation.
Fred G. Hamilton, Superintendent Mt. Whitney Power Company, Visalia.

FIRST T. P. A. MEETING.

The first of the Technical Publicity Association's monthly meetings for 1909-10 was held Thursday evening, October 14th, in its headquarters, 14 Gramercy Park, New York. There was a good attendance. All enjoyed the informal dinner, after which came an interesting program. The president of the association, Mr. Charles S. Redfield, advertising manager of the Yale and Towne Manufacturing Company, was toastmaster. The only extended address was that of Mr. George French, editor of Advertising and Selling. Preceding his remarks the attention of the members was occupied with reports of committees. The chairmen who were called upon outlined the work to be done during the winter months.

Mr. Howard M. Post, advertising manager of the Western Electric Company, told of plans for a systematic, analytical study of effectually tracing results from trade paper advertising. The keying method, he said, has proved inadequate. There should be some way of determining the effect of such advertising, declared Mr. Post. At the conclusion of a discussion of this subject in which every point of view was presented, Mr. Post was made chairman of a committee to outline this study work for the association.

"It is about time for advertisers to cease to shy at that word Psychology," said Mr. French. His remarks were an interesting presentation of the psychological and artistic aspect of advertising. His hearers were taken into the field of optics, and shown the effect advertisements have upon the eye of the reader. Mr. French took as his text the postulate of Hugh Chalmers in a recent address at Louisville. Mr. Chalmers he referred to as "the greatest salesman, perhaps the greatest advertiser, in the country." This postulate is that every sale by anyone anywhere is made in a man's mind—the mind of the one to become the purchaser.

"Advertising is profitable," said he, "only when we consider this one thing. The individual advertisers are the men who create, who place, who look at this. If I am to do anything, if I am to be effective, I have got to get the mind of the man I am to sell goods to. We all realize this, and all work towards it. If we want to arrive at any point, even if that point be the North Pole, we want to locate that place first—to fix it on the map. I will assume that in order to sell goods there must be a salesmanship message in the mind of the customer. The question is how to place that message; what kind of place is the mind; how does it comport itself; what that message is to be, and how is to be sent?"

This led to the statement of the subject, psychology. He made his chief point in the phenomenon of suggestion. "It is well to assume," continued Mr. French, "without any discussion, that every human mind is favorably inclined to receive a suggestion. This is a physiological fact, established and indisputable. There are many fallacious ideas in circulation about suggestion. There is nothing occult about it. It is not even mental, but purely a physical quality of the mind. It is guided by definite, well-known, or rather well-ascertained laws. Memories and forgotten knowledge are in the mind, and help it to make its decision.

The illustration of Mr. French gave was that of a fork in a road. "A man must decide," he said. "which way to turn, whether right or left. Once he has made his decision to go to the right, all thoughts and ideas having any connection with the left road are banished from his consciousness." Mr. French went on: "I suggest that each one of you will find that it adds greatly to his power and his clearness of expression and lucidity to look up psychology and this matter of suggestion."

Reference was made in passing to Prof. Hugo Munsterberg's "Psychotherapy." Mr. French then came to the second part of his subject, which he declared to be more or less allied with psychology. "The principles and fundamentals of art are a great help also to advertisers," he said. "This is largely mechanical, largely psychological. In advertising it is of the first importance.

"You must think of your advertisement as a picture. The eye has to have something to attract it, or a person can't be impressed. The impression is dulled unless there is a distinctive something to attract the eye, like a picture. Certain elements or qualities go to make an advertisement attractive. These are the same that lie behind every piece of art, that is, true art. Some of these are form, proportion, balance,

harmony, tone, symmetry, perspective, color. They are easy to get if in planning you have in mind their usefulness. The most common form in advertising is the oblong rectangle. This is a rule of proportion. It can't be varied without bad results. Three to five, broadly, are the proportions. This is about the shape of a magazine text page. It is also the proportions of a properly constructed cross. Radiating from the point of intersection of the cross one may work out symmetry, harmony and tone.

"A harmonious tone is almost impossible with the use of half-tone illustrations. Personally, I am very glad to see the renaissance of the line engraving, or the pen and ink sketch, in the work of advertising. It doesn't 'hog' all the attention given to the advertisement. This is a profitable line of study. Advertising may be made especially attractive, and one may trace the cause back to these principles. Some advertisers, I do not recall now just which ones, use lower-case type in the display line to produce a harmonious effect. These principles of art have never been gathered together anywhere especially for advertisers. We have to read through a good many books, and perhaps only a few pages in each have direct bearing.

"One other line of study is well worth reading up a little, and that is optics. The power of the eye is extremely limited. It seeks to reject the printed matter we seek to impress upon it. It acts in a seemingly erratic manner in reading. It doesn't travel steadily, but in jerks and jumps. These are known as fixation points. The eye wants to stop; it goes on haltingly, painfully. The normal reading line is not over 3½ inches wide. This the eye can take in with five, six or seven fixations. It should be divided up so that the eye can read it easily. Catchlines should be of such a nature that the eye can pick them up without conscious impulse —without any effort of the will. There should be no obstacles. This is of the most importance to the advertiser."

In response to a query as to the size of the type, Mr. French said:

"Type below nine-point is apt to be less agreeable than nine, ten or eleven. We must also consider the design. Only two or three designs of type face endure. All publishers have noticed how many series of type have dropped out of use. Almost all that have lasted are of the pure Roman style, because it is more agreeable to the eye. Caslon type, in use back when our fathers were born, is just as popular today."

Mr. French re-stated his thesis in the words: "It is from science and pseudo-science, from art and physiological questions such as optics, the groundwork of advertising, that we can gather a great fund of strength and knowledge. Not only that, but it is a delightful field to grub around and study in." Mr. French spoke throughout with much earnestness. His talk was highly appreciated by the advertising men present, among whom were a number of trade paper publishers. Questions were asked during the course of his remarks and a lively discussion ensued at the close. After disposing of business matters the association adjourned, to meet again in the same place on November 11th. All voted the October meeting a highly interesting and profitable one.

CURTIS TURBINE USED AS REGULATOR.

(By W. J. Davis, Jr.)

An interesting example of the effectiveness of a Curtis steam turbine when used as a regulator on a large power system is found in the new Oakland power house of the Pacific Gas and Electric Company, of San Francisco.

The installation consists of a 9,000-kilowatt vertical type Curtis turbo-generator manufactured by the General Electric Company, eight 750-horsepower McNaull water-tube boilers and a Worthington condenser outfit having a cooling surface of 20,000 square feet.

The 60,000-volt transmission system of the Pacific Gas & Electric Company entering Oakland is delivering more than 100,000 kilowatts during maximum demand. Of this amount, 20,000 kilowatts maximum are supplied to Oakland and immediate vicinity, the load factor being about sixty per cent.

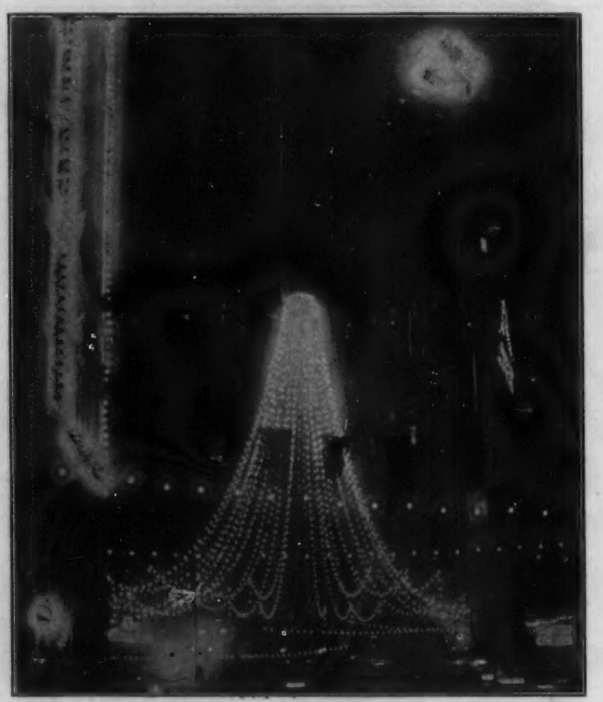
While the new plant is of great value in carrying the local peak load during hours of maximum demand, it is almost continuously kept connected to the transmission system on account of the steadying effect on the voltage and consequent improvement in the lighting service. When acting as a regulator, the duty is especially severe, the turbine taking sudden momentary swings in load from 500 to 9000 kilowatts. In a way, the action of this turbine on an alternating-current system is equivalent to that of a large storage battery on a direct-current system.

The ability of the Curtis turbine to successfully take these sudden fluctuations in load is due to the large flywheel effect (about ten times that of a reciprocating engine of equal capacity), close speed regulation, large radial clearances between moving and stationary steam-using elements, and sturdy mechanical construction.

This use of a Curtis steam turbine is particularly interesting on account of the high economy obtained under varying load. Even when the turbine is operating as a regulator the over-all economy of the plant is exceptionally good.

GRANT FLAMING ARC LAMPS ON THE SPRECKELS BUILDING.

During the Portola illuminations in San Francisco much comment was excited by the Grant Flaming Arc Lamps on the Spreckels Building, as illustrated herewith. Sixteen Grant



Flaming Arc Lamps were placed around the dome, and four inside, each of 5000 c. p. This gave an aggregate of 100,000 c. p. at a height 325 feet above the street. These lamps were installed by Parrott & Co., on a 120-volt 60-cycle a. c. circuit, two in series.

The General Electric Company has received an order from the Coalinga Light & Power Company of Coalinga, California, for a 300 k. w., 3 phase, 2300 volt, 1800 r. p. m. turbine generator set as an addition to their lighting plant.

NEWS NOTES

FINANCIAL.

EL PASO, TEX.—The bond issue for lights and sewers at Portales, N. M., has passed.

ALAMEDA, CAL.—The City Council is preparing for a bond election for the city to vote on $240,000, for public improvements.

ASETIN, WASH.—Within two months the voters of the town of Asetin will decide on a $35,000 bond issue, which will be used to cover the expense of the new water system.

ROSWELL, N. M.—The town of Hagerman has sold to John Nuveen & Co., of Chicago, bonds to the amount of $25,000, voted for the purpose of putting in a municipal water plant.

INCORPORATIONS.

SNOHOMISH, WASH.—Snohomish Electric Company has been incorporated by J. E. Wickstrom, et al., capital $200,000.

DREWSEY, ORE.—Drewsey Telephone Company of Drewsey, $3000, by S. S. Williams, J. L. Litz, John Ott, W. D. and G. L. Baker.

LOS ANGELES, CAL.—Hawxhurst Wind Turbine Power Company, capital $200,000; directors, H. I. Hawxhurst, Geo. Humphries and T. M. Webster.

LOS ANGELES, CAL.—Arlington Heights Mutual Water Company, capital stock $25,000, subscribed $7, by L. N. Brunswig, G. F. Winter, W. S. Bartlett, L. Lindsay, S. Guasit et al.

LOS ANGELES, CAL.—American Gas Engine Company, Los Angeles Directors, F. H. Coles, R. S. Bailey, D. C. Narver, R. F. Coles, D L. Narver; capital stock, $150,000; subscribed, $50

NEWPORT, WASH.—The Newport Battery Company, with a capitalization of $7000, has been incorporated to manufacture dry cell batteries, making a specialty of gasoline engine and auto battery sets.

TRANSMISSION.

NAPA, CAL.—The Snow Mountain Power Company has sold its franchises and contracts to the Napa Valley Electric Company.

HOQUIAM, WASH.—The Montesana Planing Mill Company bas been granted a franchise to install a power plant to supply electricity to the city.

GALLUP, N. M.—Contractor Miller has been awarded a contract to build a pipe line from Milk Ranch Springs to a point on the railroad near Wingate.

BILLINGS, MONT.—The Billings & Eastern Montana Power Company intends to build a power transmission line from this place to Big Timber at once.

GREER, IDAHO.—It is reported that the Lolo Milling & Mining Company has secured the water rights on Lolo and an option on the Carlson farm where it will erect a large power plant.

SAND POINT, IDAHO.—A start upon the construction of a power house and sub-station by the Northern Idaho & Montana Power Company is to take place within the next thirty days. The plans for the buildings have been made and contracts will be let according to them within the next few days. The buildings will be of brick and will cost $100,000.

OTHELLO, WASH.—The R. S. King Company of Seattle, has purchased the townsite of Othello from the C. M. & P. S. Railway and will install an electric light plant and other improvements.

JUNCTION CITY, ORE.—The Northwestern Corporation, successor to the Willamette Valley Company, has purchased the electric light plant at this place and will soon install a 24-hour service.

CRESCENT CITY, CAL.—The Smith River Electric Company will begin operations on a large power plant on Smith River, ten miles from Crescent City, within the next 90 days. It is estimated that 3250 h. p. will be generated by this plant.

WALLACE, IDAHO.—Oscar B. Wallace has closed a contract with the Washington Water Power Company of Spokane to furnish electric power for the Interstate Company near this city, and the plant will be installed as soon as the work can be accomplished. The cost of the installation is $4000.

GRANGEVILLE, IDAHO.—W. A. Sayers has completed a survey for a tunnel through a mountain dividing the Snake and Salmon rivers at a point one mile below Freedom on the Salmon River. He says that a company has been formed and $2,000,000 put up for boring a seven-mile tunnel and it is claimed that 160,000 h. p. will be developed.

TELEPHONE AND TELEGRAPH.

PUYALLUP, WASH.—The Puyallup Home Telephone Company proposes to build up its line in first class shape.

TONOPAH, NEV.—Edward Clifford has purchased from J. C. McCormick the telephone line from Tonopah to Clifford and will extend it to Ellendale and Stone Cabin.

ROSEBURG, ORE.—Contractor Grafton Worthington has been awarded the contract for erecting the new telephone exchange in this city.

WHITEFISH, MONT.—The Big Bend Light & Power Company has purchased the telephone exchange, will move the same and make several improvements.

EUREKA, CAL.—Judge Childs of Del Norte has made a trip to this city from Crescent City in the interests of an independent telephone system, planning to construct a line connecting Crescent City with Eureka.

TWIN BRIDGES, MONT.—John C. Norvell, representing the Montana Independent Telephone Company, announces that steps will be taken at once for building lines for the company in this county.

WALLACE, IDAHO.—Thaddeus S. Lane, managing director of the Montana Independent Telephone Company, announces that by April 10, 1910, long distance connections will be established between Missoula and Spokane by way of Coeur d'Alene.

SPOKANE, WASH.—Announcement comes from T. S. Lane of Butte, president of the syndicate recently organized to buy control of the Spokane company, that the Home Telephone Company of Spokane is to be in operation within six months, and that $400,000 will be expended in equipment.

ABERDEEN, WASH.—J. B. Haynes has been granted a franchise to erect a telephone line along the country road from Montesano to Aberdeen. Permission was also granted Palmer & Blair to erect a telephone line along the county road from Elma south to the site of the Union Pacific depot near the Elbow Riffle bridge.

ILLUMINATION.

PUYALLUP, WASH.—The Council has granted a franchise to C. C. Johns to construct a gas system in this city.

SAN DIEGO, CAL.—Petitions have been received by the Council for arc lights on Fourteenth, Third and Laurel streets.

CONCONULLY, WASH.—Conconully voted to issue bonds to the amount of $5500 for the construction of a water system.

CHICO, CAL.—Manager Lee Richardson of the Richardson Springs resort has gone to Sacramento and Stockton to see the machinery used in utilizing natural gas for heating and lighting purposes.

LAFAYETTE, ORE.—A franchise has been granted by the City Council for the establishment of an electric light plant, and the work of setting the poles and stringing the wire has been begun.

BILLINGS, MONT.—Billings has just installed and put into operation the first of its new ornamental lamp posts. These poles will be installed on all the streets in the business section of the town.

SAN RAFAEL, CAL.—In an interview with Wallace Foster, manager of the gas company, he states that his company will spend thousands of dollars in the improvement of the gas conditions of the city of San Rafael and in the extension of its mains to San Anselmo, Ross and Kentfield.

CAMAS, WASH.—The Western Light and Power Company has bought out the interests of C. W. Cottrell and others in the lighting and power plant the latter owned in Camas and Washougal. The purchase price of $35,000 included the damsite, powerhouses, pole and power lines and the franchises in both Camas and Washougal.

TRANSPORTATION.

ONTARIO, CAL.—D. G. Sutherland of this city has asked for a franchise to build an electric railway in Ontario.

EL PASO, TEX.—Work will begin within the next 30 days on the valley electric line between El Paso and Fabrens.

PALO ALTO, CAL.—The Peninsula Electric Railway has begun service on its new line from Palo Alto to the Stanford University campus.

WOODBURN, ORE.—The Valley Electric Railway has begun work on a spur of the Oregon Electric Railway, from W. Woodburn to Woodburn, a distance of three miles.

LOS ANGELES, CAL.—W. M. Bowen has purchased from the county an electric railway franchise to extend from the city limits on W. Adams street to Washington street.

GUADALAJARA, MEX.—The State government has just granted a concession to James H. McCreery and Richard Ivey to construct an electric railroad from Magdalena to the Santiago river at a point near Cabrera mine.

ASTORIA, ORE.—F. L. Evans of the United Public Service Company of Philadelphia, will leave there this month to take up the construction of the Seaside and Columbia River Railway, of Oregon.

SAN FRANCISCO, CAL.—The Stockton-street railway franchise granting a right of way from Market street to the Presidio with a tunnel between Sutter and Sacramento streets, has been awarded to Frank D. Stringham and his associates.

SEATTLE, WASH.—M. J. Costello, assistant manager of the Great Northern Railway, has received word of the organization of the Waterville Railway Company, which will build an electric railway from Douglass Station on the new Great Northern extension, to Waterville, a distance of five miles. The company is capitalized at $100,000. C. A. Grannis is president of the new company.

ONTARIO, CAL.—Long contemplated building of the Pacific electric lines into Ontario, seems now to have become an assured fact. The City Council is now advertising for the sale of the franchise to operate and construct the lines.

SEATTLE, WASH.—The Oregon and Washington Railway Company has let the contract for the construction of its passenger station in this city. The contract has been awarded to Thompson-Starrett Company of New York, and will cost $450,000.

WHITEBIRD, IDA.—It is reported that the Pittsburg & Gilmore Railway will construct a seven-mile tunnel through what is known as the backbone between the Salmon and Snake Rivers to convey water for an immense power plant. The project will cost about $3,000,000.

WATER WORKS.

BISBEE, ARIZ.—The citizens of Douglas have determined upon the purchase of the water plant of the Douglas Improvement Company, for which $225,000 will be paid.

LOS ANGELES, CAL.—Construction of a plant to supply water to residents of Arlington Heights and vicinity has been begun by the Arlington Heights Mutual Water Company, which has been incorporated with $25,000 capital.

LOS ANGELES, CAL.—The manager of the San Dimas Irrigation Company was authorized by directors to lay a 3-inch main west to the packing house of the San Dimas Lemon Association, so as to afford that structure better protection against fire.

BAKER CITY, ORE.—At the coming city election the people are to vote on the question of the location of the pipe line to bring in Baker's water supply from the mountains west of town. This was decided by the Council in a resolution passed by that body.

SACRAMENTO, CAL.—The City Trustees have begun active work on the establishment of a filtration plant in Sacramento. In a few weeks they will meet to go over the plans for the plant, and if they are accepted the proposition of bonding the city for the plant will be submitted to the people. Property amounting to a little more than 26 acres near the Southern Pacific grounds and the river will be condemned.

APPROVED ELECTRICAL DEVICES

FUSES, PLUG.

"D. & W." 0-30 A., 250 V. fuse casings for use with Standard cartridge enclosed fuses. Approved Oct. 11, 1909. Manufactured by

D. & W. Fuse Co., Providence, R. I.

GROUND CLAMP.

"Remco" Ground Clamp. A two-piece clamp of copper adjustable for use with ½-inch, ¾-inch, or 1-inch pipe. The ends are secured by a single bolt and provide a lug for a soldered connection to ground wire. Approved Oct. 9, 1909. Manufactured by

Rochester Electric Motor Co., Rochester, N. Y.

GROUND CLAMPS.

"S. E. Co." Cat. Nos. 6100 and 6101. Galvanized sheet steel ground clamps provided with bolt and wing nut for securing same to gas pipe and supporting lug for securing it to outlet box. Approved Oct. 11, 1909. Manufactured by

Sprague Electric Company, 527-531 W. 34th Street, New York, N. Y.

RECEPTACLES FOR ATTACHMENT PLUGS.

"Chapman" flush receptacle, Cat. Nos. 1108 and 1363, with fuseless porcelain plug, Cat. No. 1110; 12 A., 250 V. Approved Oct. 11, 1909. Manufactured by

Bryant Electric Co., Bridgeport, Conn.